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Artificial intelligence in education: implications for academic integrity and the shift toward holistic assessment

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This study examines the impact of Artificial Intelligence (AI) on the field of education, with particular focus on its implications for academic integrity and the adoption of comprehensive assessment approaches. This research fits within the specific setting of university students and faculty members in the Kingdom of Bahrain.

Methods: A cross-sectional survey was designed to examine the impact Artificial Intelligence (AI) in field of education, with particular focus on its implications for academic integrity and the adoption of comprehensive assessment approaches. A total of 218 participants were randomly selected from 250 employed in this survey study.

Results: Out of 250 invited participants, 203 responded to the survey. This study evaluated the influence of Educational Impact (EI), Policy and Ethics (PE), and Pedagogical Implications (PI) on Academic Outcomes (AO). Results revealed a significant association between EI → AO with a beta of 0.490, t-value of 4.504, and $p < 0.001$. PI also showed a significant relationship ($\beta = 0.454$, $t = 2.330$, $p = 0.010$) with more variability. PE's impact on AO was modest ($\beta = 0.243$, $t = 1.977$, $p = 0.024$). Overall, EI was the strongest AO predictor. The R^2 value was approximately 39%, indicating a good fit.

Conclusion: The research reveals a strong link between the Educational Impact (EI) of AI and academic success in Bahrain's universities, with EI being the primary predictor. Both Policy and Ethics (PE) and Pedagogical Implications (PI) play crucial roles in this relationship.

KEYWORDS

Artificial Intelligence, academic integrity, Educational Impact, Policy and Ethics, Pedagogical Implications, Academic Outcomes

1 Introduction

The advancement of technology, especially in the field of artificial intelligence (AI), has revolutionized numerous sectors, including education (Uunona and Goosen, 2023). While AI offers a plethora of advantages such as personalized learning, automated grading, and content recommendation, it also poses challenges, notably in preserving academic integrity (Sok and Heng, 2023). As AI tools become increasingly sophisticated, so too does the potential for students to utilize these technologies to gain undue advantages in their academic pursuits (Javaid et al., 2023).

Academic integrity is the foundation upon which educational institutions are built. It signifies a commitment to and the demonstration of honest scholarly work (McCabe et al., 2006; Poitras Pratt and Gladue, 2022; Sullivan, 2018). However, with the rise of AI-assisted tools, such as essay generators and automated problem solvers, students today are faced with unprecedented temptations to divert from this path of integrity (Ellison and Patel, 2022); Perkins (2023). These AI tools, while developed with the intention of aiding research and providing quicker solutions, can be easily misused (Chiang et al., 2022). This misuse undermines the very purpose of education to promote understanding, critical thinking, and genuine learning.

Furthermore, the issue is not solely about the direct use of AI to cheat. The omnipresence of these tools can inadvertently shape a student's mindset about the acceptability of seeking shortcuts in learning (Hamman, 2022). This raises a fundamental question about the role of education in the age of AI: How can institutions ensure genuine learning while leveraging the benefits of AI?

While many educators and institutions have been quick to vilify AI as the root cause of a perceived decline in academic integrity, others argue that it is the environment, teaching methodologies, and assessment strategies that need a rethink (Lin et al., 2023). For instance, if assessments are based solely on rote memorization, students might feel inclined to use AI tools as a shortcut, given the lack of depth and understanding required.

Conversely, if the focus shifts to application, critical thinking, and original content creation, AI tools might prove less tempting and less beneficial for students looking to take shortcuts (Currie, 2023). As such, while the tools themselves present challenges, they also force a necessary evolution in pedagogical approaches (Alam et al., 2022).

In exploring this topic, it's crucial to not only understand the extent and ways in which AI tools can be misused but also to discover innovative strategies educators can adopt to foster environments that deter such behavior and encourage genuine learning.

1.1 Research questions (RQ)

1 What long-term effects could AI-assisted cheating have on the educational landscape, especially with the rise of online and remote learning?
2 To what extent do application-centric assessment methods foster creativity in students compared to traditional assessment methods?
3 How can educational institutions update their academic integrity policies to address the nuances of AI-assisted cheating?

1.2 Research objectives (RO)

1 Analyzing long-term effects of AI-cheating in online learning on academic outcomes and credential value.
2 Evaluate the impact of application-centric assessments versus traditional knowledge-based assessments on student understanding, creativity, and critical thinking.
3 Examine nuances of AI-cheating in education and recommending policy updates.

This research aims to analyze the influence of artificial intelligence (AI) on academic integrity and the shift towards more comprehensive educational assessment methods in the educational sector (Figure 1).

1.3 Operational definition

1.3.1 Pedagogical Implications (PI): The measurable changes in teaching methods that the implementation of AI has brought about are demonstrated by the frequency of using AI tools in lesson plans and the rates at which instructors employ AI-driven instructional strategies.

2.3.1 Policy and Ethics (PE): The criteria and mechanisms for ethical use of artificial intelligence (AI) in education are evaluated based on the existence of institutional regulations, adherence to data privacy laws, and recorded instances of ethical violations related to AI.

3.3.1 Educational Impact (EI): The quantifiable effects of AI on student learning experiences, measured by improvements in engagement scores, personalized learning assessments, and the efficiency of AI-generated feedback.

4.3.1 Academic Outcomes (AO): The quantifiable outcomes of student performance associated with the use of artificial intelligence, assessed by comparing changes in grades, test scores, and achievement rates before and after the integration of AI.

2 Literature review

The rapid integration of artificial intelligence (AI) into the educational sphere has sparked a flurry of research and debates about its effects on academic integrity. Notably, a consensus on the severity and breadth of AI-induced cheating challenges has yet to be reached, but the existing literature provides valuable insights into the dynamics at play.

AI's Role in Education: Before understanding its implications on cheating, it's pivotal to grasp the broader role of AI in education. According to Bühler et al. (2022) AI is heralded as a revolutionary

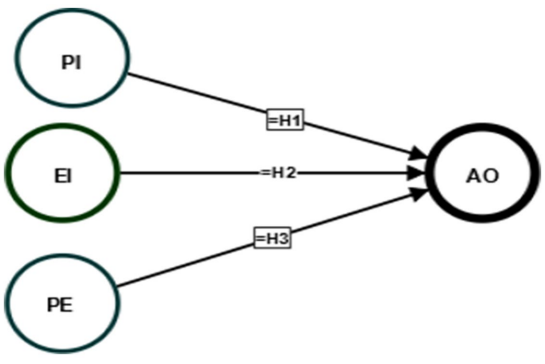

FIGURE 1
Author's own conceptual framework and hypotheses model. EI, Educational Impact; PE, Policy and Ethics; PI, Pedagogical Implications; AO, Academic Outcomes.

force in personalized learning, adaptive content delivery, and student performance analytics. The promise lies in creating bespoke educational experiences tailored to individual student needs (Alam and Mohanty, 2022; Vandenberghe et al., 2022). However, the same adaptive algorithms that can tailor learning experiences can also be utilized to generate assignment answers or even complete essays (Baidoo-Anu and Owusu Ansah, 2023; Kasneci et al., 2023; Malinka et al., 2023).

Emerging AI Tools and Cheating: Numerous AI tools, ranging from simple calculators to complex problem solvers, are now available at students' fingertips (Tucker, 2024). Dwivedi et al. (2023) categorized these tools into two: assistive and substitutive. Assistive tools aid students in understanding concepts better, while substitutive ones can replace the student in tasks, leading to a potential breach of integrity (Dhara et al., 2022; Figoli et al., 2022; Mattioli et al., 2022). An alarming trend highlighted by Khosravi et al. (2022) is the burgeoning industry of AI-driven essay mills that offer bespoke essays, often undetectable by traditional plagiarism checkers.

Pedagogical Implications: With AI's capability to complete assignments, there's an evident need to rethink assessment strategies (Chan, 2023; Ifelebuegu, 2023). Kaltenboeck et al. (2022) advocate for a shift from knowledge-based assessments to application-centric ones, as AI tools are less adept at mimicking human creativity and critical thinking. This sentiment is echoed by Song et al. (2022) who argue that the emphasis should be on open-book assessments, project-based learning, and real-world problem solving.

Institutional Measures: Educational institutions are not standing idle. Rudolph et al. (2023) detailed how schools and universities are leveraging advanced plagiarism detection tools that use AI themselves to detect artificially generated content. However, Bombaerts et al. (2023) points out that while technology can help, the solution is not solely technological but cultural. Building a strong ethos of academic integrity and ensuring students understand the value of genuine learning are equally crucial (Ateeq et al., 2024b; Fudge et al., 2022; Poitras Pratt and Gladue, 2022).

Student Perception and AI: Perhaps the most overlooked aspect is the student's viewpoint. Abu Mansour and Abu Shosha (2022) conducted a survey revealing that while students are aware of the ethical implications, they feel an immense pressure to perform, leading them to these tools. This indicates a deeper systemic issue in the current educational landscape's emphasis on grades over holistic learning (Gambhir et al., 2008; Viberg et al., 2018).

2.1 Artificial intelligence in education: implications for academic integrity and the shift toward holistic assessment

The use of artificial intelligence (AI) in academic settings has significant repercussions. Upholding academic integrity is one of the most important aspects (Perkins and Roe, 2023; Surahman and Wang, 2022; Susilawati et al., 2023). Tools that are powered by artificial intelligence, such as Turnitin, allow advanced detection of plagiarism, which ensures that students' work is unique (Chaudhry et al., 2023; Owan et al., 2023; Skavronskaya et al., 2023). Concurrently, there is a growing awareness of the ways in which AI may be abused. For example, essay generators powered by AI have the potential to create material that may evade detection by traditional methods (Narayanan and Kapoor, 2024; Rudolph et al., 2023). As a consequence of this, educators are modifying their approaches to the evaluation process (Mhlanga, 2023). The focus is changing from traditional evaluation methods to more holistic ones, such as learning via projects, giving presentations, or working on group projects. These methods not only encourage critical thinking, but they are also difficult to deceive using tools provided by artificial intelligence (Alier et al., 2024; Kenwright, 2023; Williamson and Prybutok, 2024). In conclusion, although AI technologies strengthen efforts to assure academic honesty, they also indirectly drive a turn toward evaluation systems that are more thorough and relevant. Consequently, these hypotheses are displayed in detail to ensure they achieve the objectives of the study. Therefore, this has led to the following hypothesis:

> H1 (EI → AO): The integration of AI into education will have a beneficial impact on educational impact (EI), resulting in improved academic outcomes (AO), including increased student engagement and performance.
>
> H2 (PE → AO): To ensure the responsible and equitable application of AI technologies in education, effective policies and ethical guidelines regarding AI (PE) will result in improved academic outcomes (AO).
>
> H3 (PI → AO): Changes made to teaching methods by AI will have a big effect on academic outcomes (AO), which will improve student understanding and performance in school.

3 Methodology

3.1 Ethical consideration

The research was conducted in alignment with the highest ethical standards. Participants voluntarily engaged in the study after receiving comprehensive information regarding its objectives (Ateeq et al., 2022; Habtoor and Ali, 2022). Throughout the investigation, utmost care was taken to ensure the anonymity and confidentiality of all contributors.

3.2 Research design

A research design refers to a systematic framework that is developed to effectively answer the research inquiries and ensure the collection of appropriate information for the purpose of testing the hypothesis that was proposed (Ateeq et al., 2023). The components of this framework are the unit of analysis, research inquiries, tools for data collecting, data analysis methods, and the subsequent presentation and interpretation of experimental findings. It is essential that this strategy be congruent with the research model.

As a result of the substantial sample size of university students and faculty in the several universities Kingdom of Bahrain, quantitative methodologies were implemented in this investigation. Quantitative

research is typically based on the traditional, positivist, or empirical paradigm and entails a larger sample size than qualitative research (Al-Fahim et al., 2024). Data collection was conducted using a structured questionnaire survey, which is particularly well-suited for analysis using Partial Least Squares Structural Equation Modelling (PLS-SEM).

3.3 Sample

The study focused on university students and faculty in several universities in Bahrain for instance Gulf University, examining the implications of Artificial Intelligence in education, specifically its impact on academic integrity and the trend towards holistic assessment. Out of 250 contacted via convenience sampling, 203 participants were deemed sufficient based on Krejcie and Morgan's 1970 criteria (Ali et al., 2022).

3.4 Survey

The researcher used convenience sampling to obtain statistical data for this research, which took place from August 1st to August 14th, 2023. The researcher specifically targeted those currently working in the educational industry with the electronic distribution of the questionnaire. The objective of this study was to investigate the many consequences of artificial intelligence (AI) in educational settings, particularly its impact on academic honesty and the transition towards multidimensional evaluation methods. The research effectively collected insights from an easily available subgroup of the population using convenience sampling, offering distinctive perspectives on how AI technologies are transforming educational approaches and results.

3.5 Data analysis

The research used SPSS version 28, PLS-SEM, and Amos to analyze data and examine relationships between latent variables. A Cronbach's alpha of 0.854 confirmed the questionnaire's reliability and consistency (Ateeq et al., 2023; Qaid et al., 2024).

4 Results

4.1 Background characteristics of the respondents

The study surveyed respondents' gender, age, and education. Males slightly outnumbered females, representing 54.4% ($n = 110$) and 44.4% ($n = 93$) respectively. The age distribution was diverse: 39.9% ($n = 81$) were aged 20–31, followed by 24.6% ($n = 50$) in the 31–41 bracket, 13.7% ($n = 28$) aged 41–50, and 21.6% ($n = 44$) above 50. Most respondents were undergraduates at 59.1% ($n = 120$), but a significant 40.8% ($n = 83$) held post-graduate degrees. In summary, the sample comprised a slight male majority, a larger younger demographic, and a notable proportion of post-graduates (Tables 1–8).

TABLE 1 Respondents profile.

Respondents' characteristics		*N*		(%)
Gender	Male	110		54.4
	Female	93		44.4
Age	20–31	81		39.9
	31–41	50		24.6
	41–50	28		13.7
	Above 50	44		21.6
Education	Undergrads	120		59.1
	Post-graduate	83		40.8
Total		203		

TABLE 2 $\mu \pm$ SD and rank for the variables.

Constructs	No of items	Code	$\mu \pm$ SD	Rank
Educational impact	6	EI	2. 78 ± 1.142	4
Policy and ethics	6	PE	2.851 ± 1.114	3
Pedagogical implications	5	PI	2.941 ± 0.983	1
Academic outcomes	5	AO	2.900 ± 0.982	2
Average	22		**2.897 ± 1.055**	

Rating scales: 5-point Likert scale Strongly Disagree, (2) Disagree, (3) Natural, (4) Agree, to (5) Strongly, Agree*Scores range from 1 to 5, with higher scores indicating better competence. *SD, Standard Deviation.

4.2 $\mu \pm$ SD and rank for the variables

The table presents mean scores and rankings of four educational constructs: Academic Outcomes (AO), Pedagogical Implications (PI), Policy and Ethics (PE), and Educational Impact (EI). Notably, AO, with a mean of 2.900, ranks first, indicating its paramount importance in the evaluated context. PI follows closely in the second rank, despite having a marginally higher mean of 2.941. Third is PE with 2.851, demonstrating its moderate influence. EI, with a mean of 2.78, is perceived as least impactful, ranking fourth. The minor differences in mean scores (a mere 0.120 difference between the highest and lowest) emphasize that all constructs are closely valued. However, the rank does not directly relate to the number of items, suggesting other influencing factors in the ranking process (Ateeq et al., 2024a; Milhem et al., 2024). The data, thus, highlights the nuanced significance of these constructs in the educational arena.

4.3 Multicollinearity test

Multicollinearity arises when explanatory variables in a regression model are highly correlated (Kalnins, 2022). Using variance inflation factor (Ghavifekr and Rosdy, 2015) to detect it, a VIF above 5–10 often indicates significant multicollinearity (Tai and Division, 2022). Analyzing the provided VIFs, all values are below 5, suggesting minimal multicollinearity. The highest VIF is 2.894 for EI6, still well below the concerned levels. Thus, multicollinearity does not appear to be a significant issue in this data (Giacalone et al., 2018).

TABLE 3 Multicollinearity test.

Items	VIF	Items	VIF	Items	VIF	Items	VIF
AO1	1.093	EI1	2.494	PE2	2.362	PI1	**1.954**
AO2	2.127	EI2	2.456	PE3	2.447	PI3	**1.848**
AO3	1.814	EI3	1.220	PE4	1.952	PI2	**1.990**
AO4	2.429	EI4	2.346	PE5	2.285	PI4	**1.795**
AO5	**1.910**	**EI5**	**2.171**	**PE6**	**2.038**	**PI5**	**2.171**

TABLE 4 Recommendation values of measurement variable.

Model Fit	Estimated model	Acceptable value	
ChiSqr/df	2.119	Less than 5	
RMSEA	0.064	Less than 0.08	
GFI		0.981	More than 0.90
AGFI		0.951	More than 0.90
NFI		0.969	More than 0.90
TLI		0.915	More than 0.90
CFI		**0.925**	**More than 0.90**

TABLE 5 Construct reliability and validity.

Variable	α	CR	(AVE)
AO	0.804	0.731	0.479
EI	0.807	0.886	0.576
PE	0.791	0.901	0.616
PI	0.866	0.944	0.779

EI, Educational Impact; PE, Policy and Ethics; PI, Pedagogical Implications; AO, Academic Outcomes.
Cronbach's alpha: average measure of internal consistency and item reliability and preferred when EFA is used for factor extraction. <0.7 accepted. *CR: measure scale reliability overall and preferred with CFA. ***AVE**: measures the level of variance captured by a construct 0.5 accepted. AVE, Average Variance Extracted; CR, Composite Reliability (Al-refaei et al., 2023).

4.4 Goodness-of-fit of the model

The presented model exhibits a commendable fit based on standard goodness-of-fit indices. The Chi-Square/df is 2.119, below the desired threshold of 5. The RMSEA, at 0.064, is within the favorable limit of 0.08. GFI (0.981), AGFI (0.951), NFI (0.969), TLI (0.915), and CFI (0.925) all surpass the recommended 0.90 threshold. These results suggest that the model aligns well with the data. However, while these metrics provide strong quantitative evidence of fit, a holistic model evaluation should also consider underlying theory and research implications (Ahmed et al., 2020; Ahmed et al., 2019).

4.5 Construct reliability and validity

The table presents the Cronbach's alpha (α), composite reliability (CR), and average variance extracted (AVE) of four constructs: AO, EI, PE, and PI. Firstly, all constructs show an α greater than 0.7, suggesting good internal consistency (Abro and Salam, 2014; Milhem et al., 2019).

TABLE 6 Discriminant validity.

Variables	AO	EI	PE	PI
AO	**0.616**			
EI	0.560	**0.759**		
PE	0.438	0.451	**0.785**	
PI	0.476	0.467	0.491	**0.882**

EI, Educational Impact; PE, Policy and Ethics; PI, Pedagogical Implications; AO, Academic Outcomes.
The square root of the average variance extracted is represented by diagonal, while the other elements reflect the correlation estimate (Ateeq et al., 2024c).

TABLE 7 R-square.

	R-square
AO	0.389

Higher value is preferred: 0.67 substantial, 0.33 average, 0.19 weak (Sarstedt et al., 2021).

TABLE 8 F-square.

EI → AO	0.169
PE → AO	0.039
PI → AO	0.035

EI, Educational Impact; PE, Policy and Ethics; PI, Pedagogical Implications; AO, Academic Outcomes. *Higher value is preferred: 0.67 substantial, 0.33 average, 0.19 weak (Ali and Habtoor, 2022).

In terms of CR, all values exceed the 0.7 threshold, indicating satisfactory reliability, with PI having the highest CR at 0.944 (Al-Fahim et al., 2024). Regarding Average Variance Extracted (AVE), only Average Obstruction (AO) falls below the recommended threshold of 0.5, indicating weak convergent validity. Conversely, the values of PI, EI, and PE exceed the established threshold, likely indicating the presence of issues (Milhem et al., 2024; Milhem et al., 2024). In conclusion, although all variables demonstrate strong reliability, there is need for improvement in the convergent validity of (AO), (EI), (PE).

4.6 Assessment of measurement model

In the field of educational intelligence (AI), the proposed assessment model looks at how different factors, such as educational impact (EI), policy and ethics (PE), pedagogical implications (PI), and academic outcomes (AO), are connected. The path coefficients demonstrate significant interactions among these factors, revealing both the magnitude and direction of their impacts. The observed variables show high loading values, which indicate the reliability and validity of the constructs. Also, the arrows that connect the concepts emphasize the relationships between them, which shows how well the model can understand how AI affects academic honesty and overall evaluation. See Figure 2.

4.7 Discriminant validity

Discriminant validity assesses whether concepts that should be unrelated are, in fact, unrelated. For discriminant validity to be established, the square root of the Average Variance Extracted (AVE) for a given variable should be greater than its correlation with

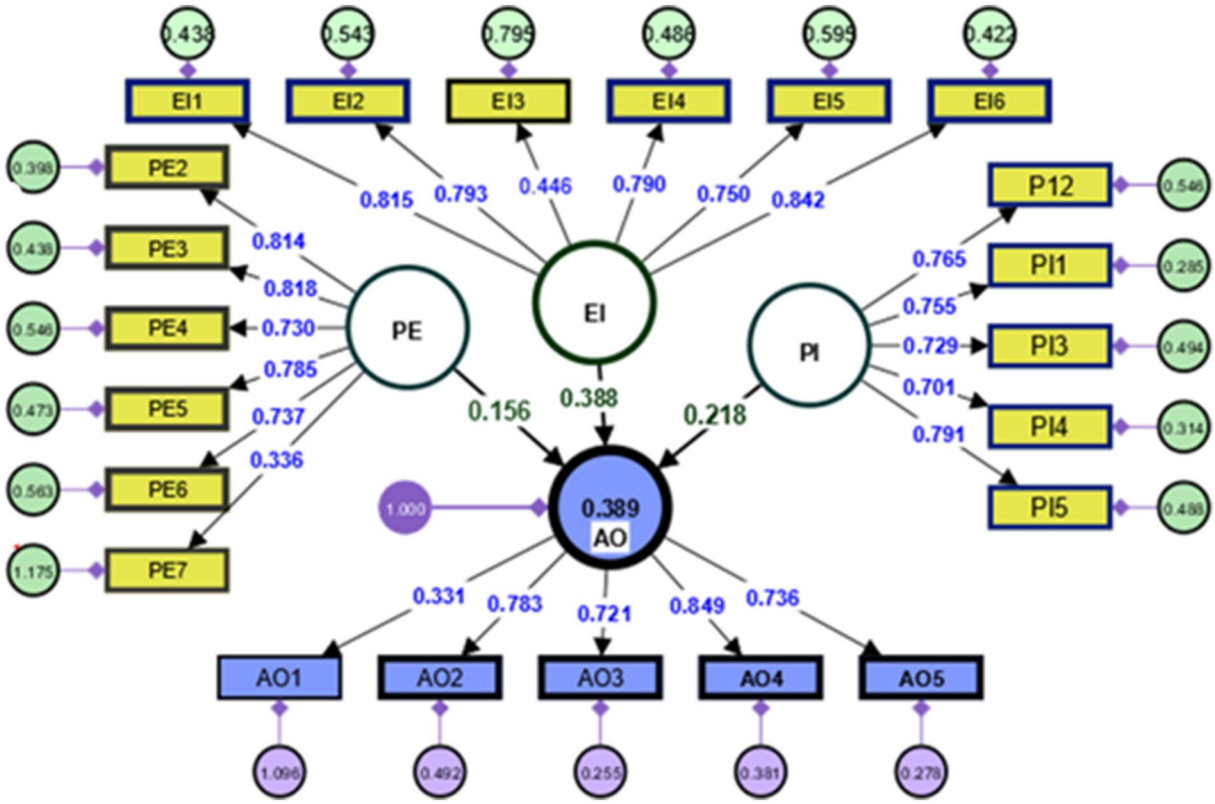

FIGURE 2

any other variable (Ateeq A.A. et al., 2024; Pehlivan et al., 2023). By examining the provided matrix, we can observe the diagonal, which presumably represents the square root of the AVE for each variable (AO, EI, PE, PI). For instance, AO's 0.616 is greater than its correlations with EI (0.560), PE (0.438), and PI (0.476). A similar pattern is observed for EI, PE, and PI. Thus, discriminant validity is confirmed for these constructs as thFe square root of each variable's AVE is greater than its correlation with the other variables (Ali et al., 2023; Ateeq et al., 2024d).

4.8 R-square

The R-square value for AO stands at 0.389. This indicates that approximately 38.9% of the variability in the dependent variable can be explained by the model, while the remaining 61.1% is unaccounted for. In many contexts, an R-square of 0.389 might be considered moderate, suggesting that while the model has some explanatory power, a significant portion of the variance remains unexplained, which might warrant further investigation or refinement of the model (Faruqe, 2023).

4.9 Effect size F^2

In the analysis of f-square values, EI to AO displays a higher value of 0.169, suggesting a more substantial effect on AO compared to PE and PI, which exhibit lower effects of 0.039 and 0.035, respectively. This implies that EI has the most pronounced influence on AO among the predictors.

4.10 Factor loadings of all constructs construct

Table 9 lists factor loadings for various items under four variables: AO, EI, PE, and PI. Analysing the loadings, AO's items, especially AO4, show strong loadings with AO2 and AO5 following closely. For EI, EI6 has the highest loading, while EI3 stands out as a weak link, potentially indicating less relevance or reliability in that item. PE's loadings are consistent, with PE2 and PE3 leading; however, PE7 is noticeably weaker and might be less impactful. Lastly, PI items have a tight range of strong loadings, led by PI5. Overall, the majority of items exhibit strong factor loadings, with a few outliers that may require further scrutiny (Alzoraiki et al., 2024; Mede et al., 2022).

4.11 The assessment of the inner model and hypotheses testing procedures

The findings reveal the substantial relationships among the underlying concepts of Educational Impact (EI), Policy and Ethics (PE), Pedagogical Implications (PI), and their impact on Academic outcomes (AO). With a coefficient of 0.388, a high T-value of 4.55, and a p-value of 0.000, the path from EI to AO has a substantial

TABLE 9 Factor loadings of all constructs construct.

Items	AO	EI	PE	PI
AO1	0.331			
AO2	0.783			
AO3	0.721			
AO4	0.849			
AO5	0.736			
EI1		0.815		
EI2		0.793		
EI3		0.446		
EI4		0.790		
EI5		0.750		
EI6		0.842		
PE2			0.814	
PE3			0.818	
PE4			0.730	
PE5			0.785	
PE6			0.737	
PE7			0.336	
PI1				0.755
PI2				0.765
PI3				0.729
PI4				0.701
PI5				0.791

positive impact, demonstrating a statistically significant and robust link. These findings indicate that educational interventions, such as well-designed curriculum, effective teaching approaches, and active student participation, significantly impact academic results. This link highlights the crucial importance of effectively designed educational practices in enhancing student achievement and success. Nevertheless, the correlation between PE and AO, although noteworthy, is less pronounced in comparison to EI. With a coefficient of 0.156, a *T*-value of 2.04, and a *p*-value of 0.024, this route suggests that the impact of institutional regulations and ethical practices on academic results is modest. These findings indicate that while policies and ethical principles have a role in influencing the learning environment, their direct influence on student achievement is less significant compared to the instructional techniques themselves. However, strict compliance with effective regulations and ethical principles continues to have a beneficial impact on the general academic achievement of college students. The route from PI to AO shows a modest impact, with a coefficient of 0.218, a *T*-value of 2.34, and a *p*-value of 0.010. The aforementioned statement implies that pedagogical strategies, such as instructional innovations, student-teacher interactions, and adaptive teaching techniques, have a significant but not predominant impact on academic achievements. The continued importance of pedagogy in promoting successful learning environments is contingent upon its ability to effectively complement wider educational interventions. Collectively, the results underscore the crucial importance of educational techniques in shaping academic results, with both legislative frameworks and instructional approaches playing supporting but substantial roles. Educational institutions seeking to improve academic achievement should prioritize the quality of education while simultaneously improving policies and teaching methods to provide a comprehensive and efficient learning environment (Table 10).

5 Discussion

Understanding the dynamics between various factors and academic outcomes has long been the subject of numerous studies (Reardon, 2011; Roy, 2023). The current findings throw light on the roles of Educational Impact (EI), Pedagogical Implications (PI), and Policy and Ethics (PE) in shaping Academic Outcomes (AO). This discussion aims to critically analyze the results of these hypotheses in the context of previous research, exploring the nuances of their interrelationships and the implications they hold for the educational realm.

To start, the most dominant predictor of AO in this study was Educational Impact (EI), evidenced by its impressive beta coefficient of 0.490. Historically, many educational researchers have touted the importance of the educational environment, resources, and teaching methodologies in determining students' academic performance (Howard-Gosse et al., 2023). For instance, Almulla and Al-Rahmi (2023) found a substantial positive correlation between quality teaching resources and improved student outcomes, a sentiment that resonates with the results of H1. Furthermore, Odei-Tettey et al. (2023) highlighted that a well-structured educational system that offers holistic learning experiences significantly improves academic results. Our finding complements these assertions, solidifying the notion that the impact of education has a pronounced effect on AO.

Meanwhile, the influence of Pedagogical Implications (PI) on AO, though significant, demonstrated notable variability. The world of education has witnessed an array of pedagogical shifts over the past few decades, ranging from traditional lecture-based approaches to more interactive, student-centered methodologies (Muscatello, 2023). The significant beta value of 0.454 in H3 is reflective of the importance of pedagogy, which aligns with (Habibi et al., 2023) findings. However, the variability present might be attributed to the multitude of pedagogical strategies available and their differential effectiveness across diverse student populations (Hoffmann et al., 2023). For example, while collaborative learning might prove effective for one group, problem-based learning could be more suited for another. This suggests that while PI remains a key determinant of AO, its effectiveness can vary based on its application and context.

Lastly, the association between Policy and Ethics (PE) and AO, as deduced from H2, seems more moderate when compared with EI and PI. This could stem from the indirect nature of policy and ethics' impact on academic outcomes. For instance, while schools and institutions may abide by certain educational policies, their translation into classroom practices and eventual student outcomes might not be straightforward (Masters, 2023). Moreover, ethical considerations, such as fairness in assessment and equal opportunities, while foundational, might not show immediate or pronounced effects on AO. Nevertheless, the significance of the PE → AO relationship, as evidenced by the *p*-value of 0.024, cannot be ignored. It accentuates that even the subtler aspects of education, like policy and ethics, play

TABLE 10 Mean, STDEV, *T* values, *p* values, decision.

Hypothesis	β	μ	SD	*T*-Value	*p* values	Decision
EI → AO	0.388	0.496	0.109	4.55	0.000	Supported
PE → AO	0.156	0.251	0.123	2.04	0.024	Supported
PI → AO	0.218	0.456	0.195	2.34	0.010	Supported

EI, Educational Impact; PE, Policy and Ethics; PI, Pedagogical Implications; AO, Academic Outcomes.
Beta (β); Values from −1 to +1. Assess significance and confidence intervals. *p*-values; Significance value is based on the degrees of freedom $p < 0.05$ Cheah (2020).

a critical role in determining academic trajectories (Oliveira et al., 2023).

Drawing parallels with previous studies, it's intriguing to observe the dynamic interplay between these three variables and AO. While each predictor has its unique importance, their collective influence on academic results is undeniable. For future investigations, delving deeper into the intricacies of these relationships can offer granular insights. For instance, exploring which specific elements within EI or PI exert the most influence can help educators fine-tune their strategies for enhanced outcomes.

In conclusion, the present study, in synergy with historical research, underscores the paramountcy of Educational Impact in predicting Academic Outcomes. While Pedagogical Implications and Policy and Ethics have their respective roles, it's the holistic and encompassing nature of the educational impact that stands out as the most formidable determinant of AO. As educational stakeholders, recognizing and harnessing these insights can pave the way for more informed decisions and strategic implementations in the academic arena.

5.1 Limitations

The limitations of the research include a possible bias in the selection of the sample, hence potentially limiting its ability to accurately reflect the wider student population. The potential limitations of relying just on beta coefficients include the possibility of overlooking intricate interactions between factors. Additionally, it should be noted that the research operates on the assumption of a linear relationship between various variables and academic achievements, consequently disregarding the possible impact of non-linear impacts. Finally, it should be noted that there are other external factors, such as socio-economic position and cultural influences, which were not taken into consideration in this research, but might potentially have an effect on AO.

5.2 Recommendations

Considering the complexities presented by artificial intelligence (AI) in upholding academic integrity, it is imperative to embrace a comprehensive approach to evaluation within the realm of education. This method prioritizes the cultivation of authentic learning experiences as opposed to rote memorization. Given the substantial impact of educational approaches on academic achievements and the variation in efficacy depending on their execution, it is imperative for educators and policymakers to emphasize the comprehension of these processes. This will empower individuals to develop tactics that enhance authentic learning experiences and preserve the integrity of academic accomplishments.

6 Conclusion

The incorporation of artificial intelligence (AI) in the field of education has given rise to apprehensions over the preservation of academic integrity, primarily owing to the proliferation of advanced cheating techniques. The use of a holistic assessment approach serves to alleviate these concerns, fostering a comprehensive comprehension of students' abilities. The integration of technology and education prioritizes authentic learning experiences rather than rote memorization. The research validates the idea that educational influence plays a substantial role in shaping academic achievements, whereas the effectiveness of pedagogical approaches exhibits diverse consequences depending on their implementation. Therefore, it is crucial to comprehend these processes, prompting educators and policymakers to implement comprehensive solutions in order to maximize the effectiveness of learning.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

AA: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. MA: Writing – review & editing, Validation, Methodology, Investigation, Funding acquisition. MM: Writing – review & editing, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition. RA: Writing – review & editing, Supervision,

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

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